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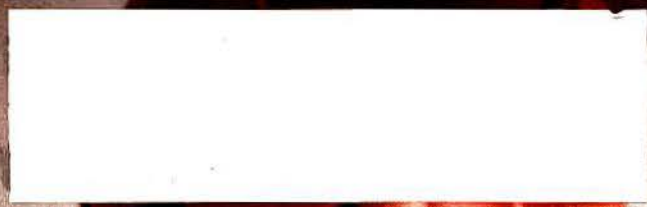
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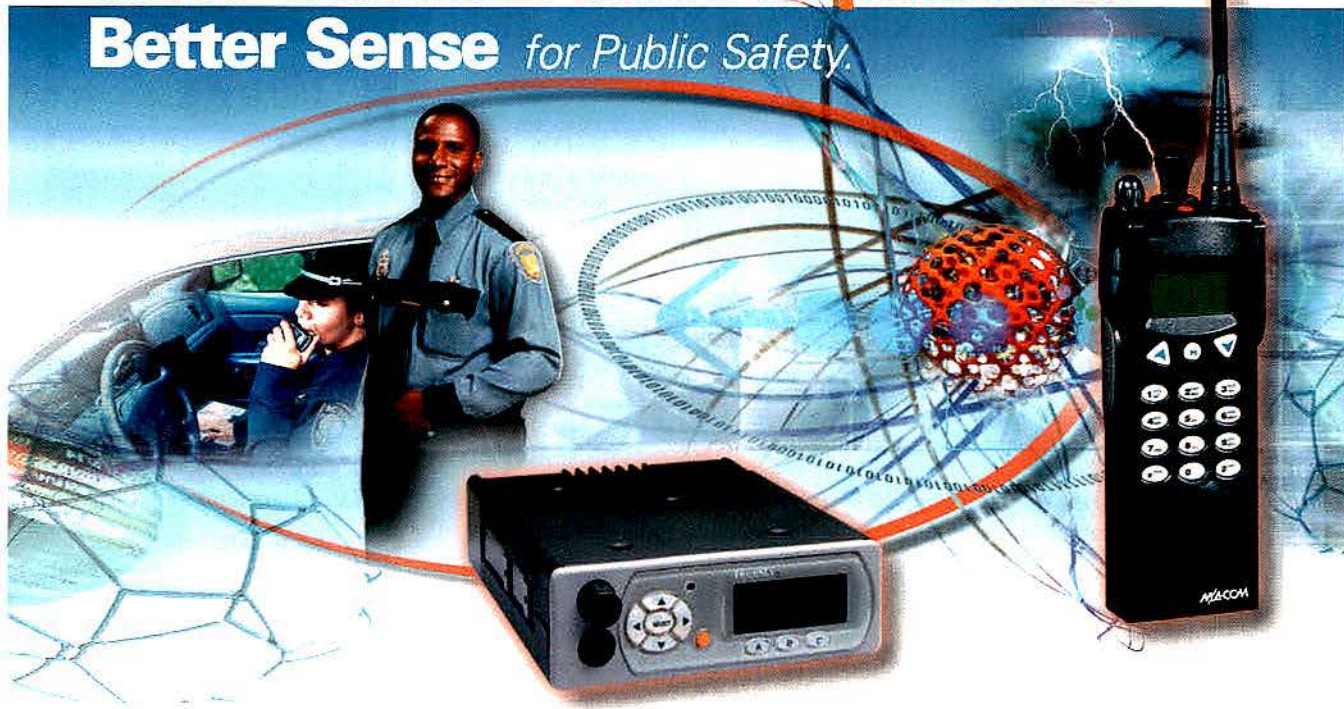
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OCTOBER 2001
Volume 19, Issue 10

On the cover: Find out what has been happening with the 700MHz band for PLMR and CMRS. See page 26.

Columnist Harold Kinley explores a quick method for finding a short. See page 20.



Features

- 12 PUBLIC SAFETY: Squelching the long, hot summer**
James Careless
North America has been plagued by forest fires this year, but British Columbia's use of land mobile and satellite radio has helped it beat the heat.
- 26 COVER STORY: 700MHz: Trick or treat?**
Kari Taylor
The 700MHz guardband auction lured several masqueraders with outstretched gunnysacks. When the radio industry finally sees some results, will 700MHz be a treat or a trick?
- 30 Multiple choices for critical communications**
Ron Bender and Jay Herther
When facing the design of a private wireless network, many public agencies and private companies encounter a "one technology fits all" approach by vendors.
- 48 Web site directory**
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ON THE WEB AT WWW.MRTMAG.COM:



Hijacked airliners hit World Trade Center, Pentagon
Rescue workers draw upon communications resources to support efforts to aid victims.



He ain't heavy, he's my parabolic
Marcello Praca Gomes da Silva
Calculate solid antenna area for terrestrial microwave antenna to determine tower wind-loading effects.



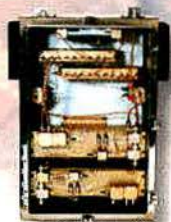
The power within
Jeffrey Ashley
Understand common power sources for communications facilities.

Departments

- 4 In sync**
Don Bishop
Gated community or RV park?
- 6 In the public interest**
Robert H. Schwaninger Jr.
I've got connections
- 10 Public safety: '10-2'**
David O. Dunford
Communication issues for autumn
- 20 Technically speaking**
Harold Kinley, C.E.T.
Finding the short—a short and sure way
- 33 Ad index**
- 36 Product focus**
Mics for portables
- 38 Products**
Product encore: Test equipment
- 40 Classified**



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CIRCLE (5) ON FAST FACT CARD

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Gated community or RV park?

Private and commercial radio system operators won't have to wait nearly as long as their counterparts in public safety to put 700MHz spectrum to use.

While public safety representatives continue their work on standards intended to foster inter-

operability in their 24MHz allocation in the 700MHz band, private and commercial system operators don't have exactly the same concerns. As a result, future 700MHz system operators may find a choice of technologies coming available next year as

manufacturers move through the product development and FCC certification process.

Meanwhile, owners of the 700MHz private and commercial radio spectrum are readying their plans for leasing channels in various bandwidths and for various geographic areas for voice and data use. If equipment were available now, some of the spectrum already might be leased and placed in use.

Mark Crosby, president of Access Spectrum, indicated that equipment for point-to-multipoint data communications might be available in as little as five months, with the first two-way radio infrastructure, portable and mobile equipment coming on the market as early as next summer. Crosby outlined Access Spectrum's plans to an audience at the Small Business in Telecommunications "Fall Classic" conference in Nashville, TN, on Sept. 6.

Access Spectrum spent \$78 million to purchase 700MHz private and commercial radio spectrum in an FCC auction last year. Two other bidders also made large purchases. Nextel Communications, a nationwide wireless telephone system operator, spent \$345 million; and Pegasus, a broadcast and cable TV company, spent \$95 million. Only Access Spectrum has made its

plans public, so far.

"We're building a gated community," Crosby said, referring to Access Spectrum's ability to control channel assignments among its spectrum lessees. "You design the lot (bandwidth and geographic coverage) and the building (the chosen technology), and we're going to make sure, because it's in our best interest, that there's no foolishness going on in this band."

In comparison, Crosby described the VHF and UHF bands as an RV park where system operators may receive interference from other users with overlapping coverage areas and incompatible operating patterns. (See our cover story on page 26 for a more complete 700MHz update, which includes an interview with Crosby.)

Meanwhile, spectrum lease fees have yet to be publicized. One system operator who heard Crosby speak at SBT made a quick calculation based on his understanding of Access Spectrum's operating and interest expenses and figured channels might be leased for \$1,000 per month. Crosby said he thought portables would cost no more than \$400 to \$500.

The system operator said he thought it might be necessary to charge users as much as \$50 per month to offset the spectrum lease expense. This compares to the \$20 to \$35 that operators charge for airtime on VHF and UHF systems in the "RV park." It begins to approach the average \$72 that Nextel now charges for 800MHz service.

Private users and commercial system operators should consider the possibilities for early deployment at 700MHz, especially in areas with pent-up demand.

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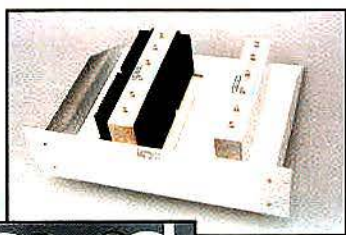
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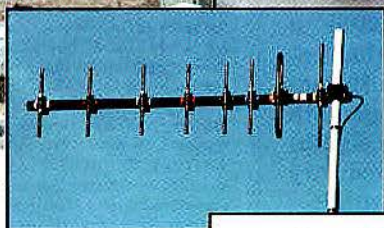
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I've got connections

By Robert H. Schwaninger Jr.

The dynamics of the telecommunications industry, as viewed through expert eyes, include a review of the greater convergence of both wired and wireless flexibility to meet the demands of the marketplace. This convergence is meeting acceptance as—BEEP ... as—BEEP ... just a minute.

*Hello! Hello!
Press red flashing button, and
there we have it.
Darn! Cut 'em off!*

As I was saying—er—writing, the convergence of wireless and wired communications began with basic interconnection efforts via the early attempts to provide mobile phone service in what was then a crude simplex configuration. From these early experiments in the ...

*Secretary just handed me an urgent fax.
The pages aren't in order.
The stupid machine reduced one page.
Typeface is about the size of an ant's butt.*

*I can't read this!
Call them and get them to resend.
You tried, and all you got was voice mail!*

OK, where was I? Oh, yes—the early experiments in connectivity and convergence created a groundswell of demand that enjoyed its first zenith with the advent of cellular radio. Then, with the introduction of true digital technology, the face of the industry changed again, bringing with it—YOU'VE GOT MAIL.

*So what? I'm trying to write here!
But it might be important, like some client with the FCC enforcement guys toting off his shop.*

OK. OPEN EMAIL
"IMPORTANT OFFER FOR FIRST-TIME HOME BUYERS."
G-a-a-h!!!!

If you were here, I'd tell you what a first-class @%&\$\$% you are!

Let's try this again.
... bringing with it the hope of a fully interconnected and interactive mobile data/video solution. Convergence on wire, via fiber, would be matched by convergence in wireless via broadband, high-speed data streams that the industry has dubbed third generation, or 3G. This promise ...



Future Shock.

*I've got a call on hold about the
paging auction ...
New phone system.
Now, let's see, hit the green flashing bar.
Pick up receiver and ...*

Schwaninger, MRT's regulatory consultant, is the principal in the law firm of Schwaninger & Associates, Washington, which is counsel to Small Business in Telecommunications. Schwaninger is also a member of the Radio Club of America. We'd tell you his email address, but we think we had better wait a month.

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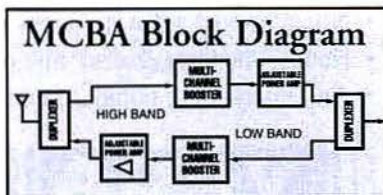
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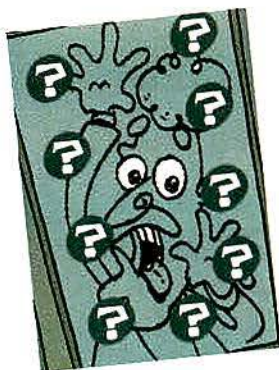
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AOL instant message

Darn thing just pops up on the screen.

John: Robert, will you be available for a phone call later?

Robert: John, what time?

John: What's convenient?

Robert: How long?

John: Just a minute or two to discuss CALEA.

Robert: How about three?

John: Three's no good.

Robert: When?

John: Four.

Robert: Four's good.

John: Thanks.

Robert: You're welcome.

John: Signing off.

Robert: Signing off.

Hit INTCOM key on phone and tell secretary to schedule a four o'clock call with John. She tells me that the phone company is coming to check the router on the network and that the phone system will likely be out of service while they try to figure out the DSL problem. I tell her to call John and tell him to either reschedule or to call the number for her cellphone (I don't own one). She tells me that her cellphone was carried off by the dog, and she couldn't find it this morning. Sigh.

New column

Dear readers: As I sit here among the electronic waves that wash up from my computer screen, dash through the air and buzz through the wiring in my office, I consider both the promise and curse of telecommunications and "being connected." Having been immersed in this industry for a second decade, I must remind myself that proximity to progress does not equal immunity from aggravation. It would not surprise me to find that the CEO of SBC works only with quill and parchment, with the added assistance of an agreeable carrier pigeon.

If you want to discuss this further, write me, call me, email me, instant-message me, fax me, check out my Web page, leave a message in my voice mail, post a note in my chat room, UPS me, FedEx me, page me, get me on a cell, call the home, conference me in, cc me, forward it to me, route me through, connect me to, dial me up, bookmark me, pencil me in, send me an attachment, reconfig docs to me ... or just drop by for a beer.

Hint: The guy with the beer will be considered "priority communications." Some things never change. Thank God. ■

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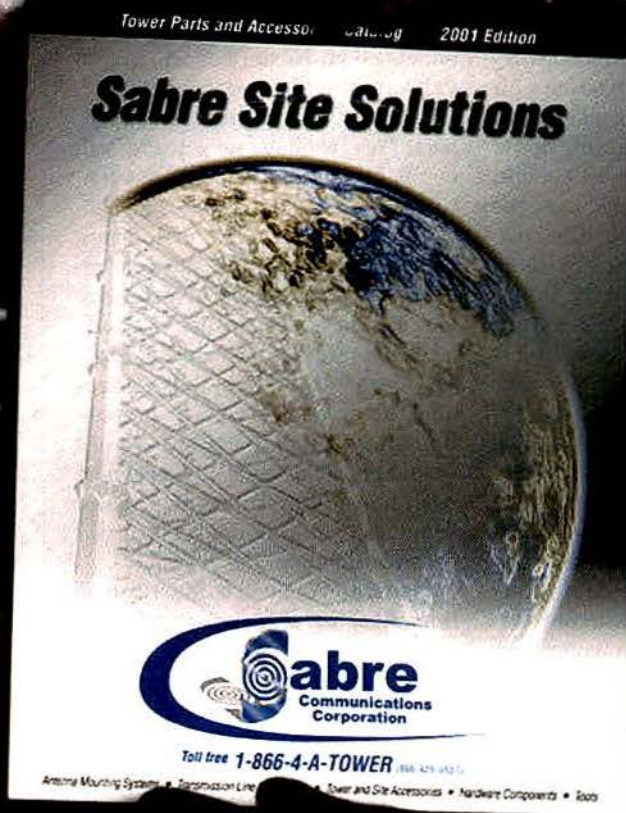
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CIRCLE (9) ON FAST FACT CARD

Communication issues for autumn

'Have a nice fall'

By David O. Dunford

Fall is my favorite time of year. The weeds at the tower site will be gone soon. We older people take delight when we can tower-climb without getting heat exhaustion. Cheap mastic pads and imported electrical tapes don't melt and stick to your fingers in October. We could warm ourselves with thoughts of pending wintertime fellowship and holiday cheer if it weren't for pesky distractions such as:

Issue 1. Konrad Brown is a tenured Motorola salesman from the days when knowledgeable factory people actually sold products for that firm. Recently, Konrad sent out a brief email giving a "heads up" to his customers about the FCC audit letters that will be mailed over the next several months. For the curious or disbelieving, he included the Internet link directly to the FCC's Web page notice. This story, related "audit letter" and the actions of the commission provoke awe and amazement.

You can make an automobile fly if you bolt on enough parts, but would you want to fly across the country in it? The FCC's IT staff has been bolting more parts onto the ULS trying to get it off the ground. After all of the—well let's just call it "bureaucratic process"—to get the computerized ULS up and operating, the FCC is nearly finished.

But the system only works when we, the system users, operators and licensees, send all the correct data back to the FCC, which is where it came from originally. I wish they had just called it an audit of "sketchy records" instead of an audit of "construction and operational

status." We on the technical side of licensee operations can well understand what it's like to have a few bits of missing data.

Be sure to fill out the forms and furnish the requested information. While you're at it, take a cue from Konrad and notify your customers or other nearby user agencies about this pending mass mailer.

Issue 2. Did someone say Nextel? In our neck of the woods the use of Nextel handsets by public safety is growing. We've seen a flurry of emails about Nextel's efforts to provide cross-fleet direct connect and, eventually, nationwide direct connect. "Yes, we have no privacy" will be the marketing theme of that venture. Because these devices can benefit public safety by offloading non-critical traffic from our real radio systems, why doesn't Nextel give us a leg up? My suggestion to Sandy Baer, who works in Nextel's Reston, VA, brain box, is to establish a parallel sub-system specifically for public safety. Such a hookup would permit cross-fleet-like direct connect with non-public safety users and provide a reliable degree of talk-path availability.

Issue 3. We need to start thinking in terms of "mobile information" instead of "mobile data." Many agencies already have mobile data, and like most early data communications, it rolls along at a sleepy pace. Even though NCIC 2000 was planned with a suite of services based on 4800 baud throughput, consumer wireless Internet applications should drive the deployment of more advanced services. It would be a real asset to public safety if Radioman could help with new and emerging mobile information technologies.

Have an enjoyable autumn, when you go for a walk leave the Nextel at home, and trust the FCC. They're here to help us. ■

Dunford, MRT's public safety consultant, is technical services consultant for the Lenexa, KS, Police Department. He is a member of the Association of Public-Safety Communications Officials-International. You can email Dunford at mrt@intertec.com.

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CIRCLE (10) ON FAST FACT CARD

Squelching the long, hot summer

North America has been plagued by forest fires this year, but British Columbia's use of land mobile and satellite radio has helped it beat the heat.

By James Careless

The long, hot summer of 2001 brought heavy fire activity to forests across North America. By mid-August, the United States was already running above its

suffering the most activity. In Canada, by mid-August, there had already been more than 6,400 fires involving 1.5 million acres, with the strongest fire activity occurring in Alberta, Saskatchewan and the Northwest Territory. British Columbia, however, was running below its average in August, with 1,041 reported fires involving 15,666 acres (24.5 square miles). One reason British Columbia is successful in beating the heat may be its firefighting organization and communications deployment.

Covering an area of about 227,800 square miles—about two-thirds of the entire province—British Columbia's publicly owned forests are the lifeblood of its economy. That is why the B.C. Ministry of Forests takes forest fires so seriously. In an average year, it has to combat about 3,000 wildfires; half caused by lightning and half by humans. About 90 square miles of timber go up in smoke annually. It's like burning money, as far as the B.C. economy is concerned.

To protect British Columbia's far-flung forests effectively, the province has divided them into six "fire centers." Each center has its firefighting teams, water-bombing aircraft and exten-

sive support facilities—including radio communications. Meanwhile, the overall operation is overseen by the Protection Branch, based in Victoria. The PB is connected to field operations by an "administration network" that comprises voice and high-speed data services.

When it comes to providing radio support for British Columbia's forest firefighters, John Flanagan is a key player. As a fire operations specialist with the Ministry's Protection Branch, Flanagan is one of the people who provide two-way radio communications; both data and voice.

B.C. firefighting radio

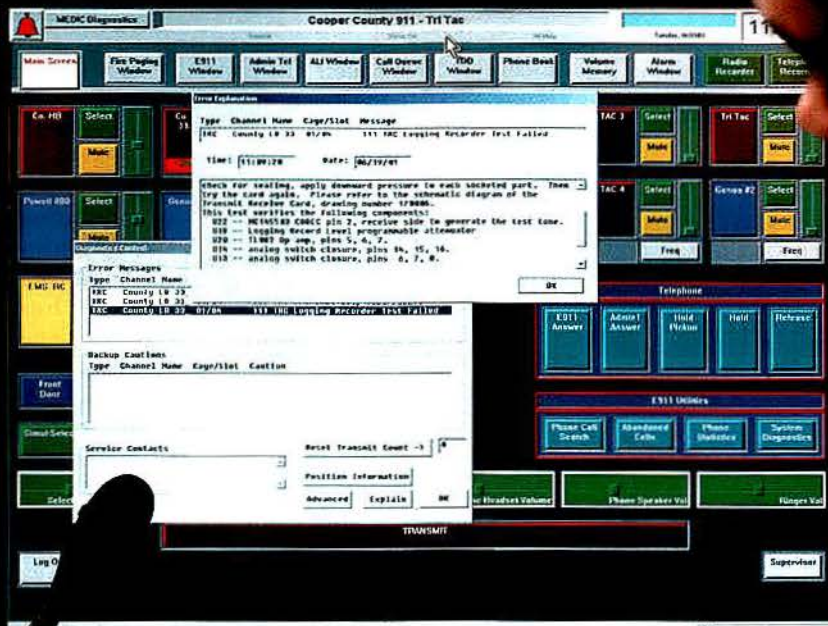
With the majority of British Columbia's population living within 200 miles of the Canada/U.S. border, a large, rural part of the province has limited communications infrastructure. As a result, "the Protection Branch has had to install over 325 mountaintop repeater sites across the province," Flanagan said. Many of these repeaters are in remote locations, so equipment has to be delivered by helicopter. Once installed, the repeaters are meant to operate automatically, without human intervention and with only annual maintenance, if required.

Of course, a B.C. mountaintop is hardly the most hospitable of transmitter sites. That's why each repeater is housed inside a protective



10-year average for acreage affected by wildfire—more than 2.8 million acres—with the Southern region (particularly Texas and Oklahoma) and the Pacific Northwest region

Careless is a freelance telecommunications writer based in Ottawa, ON, Canada. His email address is james@tjtdesign.com.



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Fiberglass "com shell." The housing is guy-wired to the mountain's rock face to keep the installation from blowing away and to prevent exces-

Left: This helicopter-deployable resource tracking repeater operates at 44.5MHz and is used to track fire control aircraft. The com shell houses the transmitter, repeater, batteries and antenna.

sive ice and snow buildups.

Within the shell, there is a series of rechargeable batteries, a rack-mounted transmitter tuned to VHF highband, and either an omnidirectional or a dipole antenna array measuring a total of 10' in length. As for power, 85% of the shells have externally mounted solar panels that feed the equipment inside. Where proximity allows, electrical transmission lines are tapped for ac power for the remaining 15% of the installations.

"The com shells tend to make the equipment last a bit longer, and give a higher probability of survival against the elements," Flanagan said, "even though they still get hit by lightning or are blown off the mountain by 150mph winds or crushed under many feet of ice and snow."

On the ground—and in the air

British Columbia's firefighters tend to work in three-man crews; each equipped with two hand-held radios. Each vehicle is also usually equipped with a multichannel unit that covers fire, logging and other key radio frequencies.

The firefighters use a mixed bag of radios. "For the ground crews, we utilize a lot of ICOM F3 32-channel hand-helds," Flanagan said. "We also have some older ICOM H19s and H16s, but presently we are getting rid of all the H12s. They were a great radio in their day, but they only have 12 channels. The minimum amount of channels required for our crews is 16. In the vehicles we utilize mainly TAD mobile radios."

Meanwhile, on-board British Columbia's helicopters and water-bombing aircraft, the crews use either Bendix King or Northern Airborne Technologies transceivers. "They're great radios," Flanagan said.

The frequencies

If you're in British Columbia and you tune your receiver to between 160MHz and 170MHz, chances are you'll hear the forest firefighters on the air. "The network [comprises]

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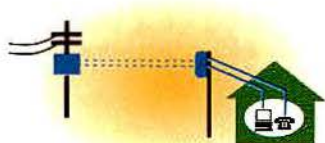


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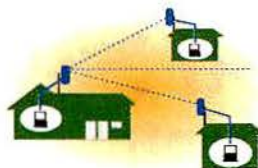
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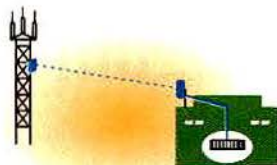
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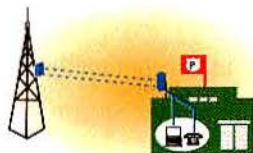
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Unfortunately, there's one hitch to British Columbia's radio system: It can't be heard *everywhere*. On the ground, only 65% of the province's land mass is covered. In the air, it increases to 70%. That is why the Protection Branch is increasingly turning to Globalstar satellite phones. With Globalstar, crews can be heard wherever they are, Flanagan said. Globalstar also

about 10 duplex frequencies spread out among the regions and three simplex frequencies, province-wide," Flanagan said. "We also have a simplex frequency at 164.04MHz to manage planes dropping fire retardant, as well as channels between 122MHz and 129MHz for managing the air tankers. We also have addi-

tional frequencies that can be used in some areas but are not licensed for use in the entire province."

The Protection Branch's radio system is CTCSS tone-activated. Not only does this keep crosstalk to a minimum, but it also allows one region to activate the entire network when necessary.

makes it easy for air crews to get through to the control tower.

"They just phone in, rather than wait to cut through radio chatter," Flanagan said. "This improves our communications when we provide aid to other provinces or U.S. states for a quick 'splash and dash' water-bombing run, by being able to

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Weight (ounces)	16	25	27	28	Submersible	2 Meters	No	No	No
Power (watts)	5	5	5	5	Keypad Programming	Yes	No	No	Yes
Channels	256	255	255	256	Battery Meter	Yes	No	No	No

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call them up instead of programming-in their frequencies to our radios."

Finally, the PB has started to deploy repeater sites that use Globalstar links. With these systems, there's no need to string a

number of terrestrial towers to forward the signal to them, Flanagan said. Instead, all his people have to do is install the repeater, then dial it up remotely from the Fire Center or from the PB's Victoria headquarters.

Whenever a serious forest fire breaks out in British Columbia, the PB's electronics experts map out a communications plan. The plan includes the frequencies to be used and the number of sets required, and it assigns a ministry technician to manage the network onsite. The radios are then dispatched to the scene as soon as possible, usually by air.

The number of frequencies available onsite is critically important. Typically, 150 radios might be used at one time. That's why each group—ground crews, aircraft and medical—are given their own sets of frequencies. Otherwise, the resulting cross-chatter would make meaningful communications impossible.

When things get crazy, the Protection Branch can dispatch a communications trailer to the site. The trailer is one element of a nine-unit tractor-trailer "fire camp" that can be trucked in as needed. Resembling a "M*A*S*H*" unit, the fire camp also provides a warehouse unit, a kitchen trailer and a wash trailer—everything to support as many as 200 people onsite. Meanwhile, extra radios are available, in cases of 10, as needed, Flanagan said. Thirty-five cases are stored in Victoria for such instances, and more cases can be ordered from other provinces' stock as required.

Firefighting radio

Without a doubt, it comes down to traffic management and coverage. Traffic is handled by deploying extra radios—or even a portable base station—as warranted. Coverage is a matter of mountaintop towers and satellite phones.

Do these two factors keep John Flanagan up at night? Not on your life. For him, and the rest of British Columbia's Protection Branch, forest fires are a fact of life. That's why they've developed such a sophisticated radio network to handle them, and why 96% of all forest fires are doused before they exceed four acres in size. Clearly, in British Columbia, two-way radio is making a difference. ■

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CIRCLE (17) ON FAST FACT CARD

Finding the short—a short and sure way

By Harold Kinley

Are you stuck on a short-circuit problem? Here's a short and sure solution. Well, some might disagree about how *short* in terms of time the method might be; but it would be hard to argue with the *sure* part. In fact, the time required isn't so long either—it just

takes longer to describe it than to do it.

This method for finding a short was described many years ago by the affable and venerable Bill Detwiler, founder of Helper Instruments. Bill might have described this procedure as one of the possible applications of one of his company's products—a dc power supply. Although I don't use the power supply, I certainly have used this idea many times over the years and with great success. The procedure is presented here as a *pictorial* with text as needed. We are looking for a short circuit between ground and the A+ rail.

Usually, the procedure is implemented by first *tacking* (soldering) a couple of wire posts to either end of the A+ rail. It is assumed that one lead of the shorted device is connected to the A+ rail between the two posts that are temporarily tacked in place on either end of the A+ rail. (See Photo 1 at the left.) Here, a Radio Shack perforated board is used to demonstrate the technique. The A+ rail is represented by the circuit trace near the top, with a black wire tacked to the left side and a red wire tacked to the right side. The ground rail is represented by the lower trace with the green wire attached to its center.

Between the A+ rail and the ground rail are attached several simulated components. These are just twisted wires with only one of the twisted pair shorted together. (See Photo 2 at the left.) Now, the object is to determine the precise location of the short between the A+ rail and ground. The basic diagram of the setup is shown in Figure 1 on page 24.

A 2.2 Ω resistor and a 1.5V "C" or "D" cell are used to produce a current flow. The amount of current should be kept to a level just great enough to produce a usable

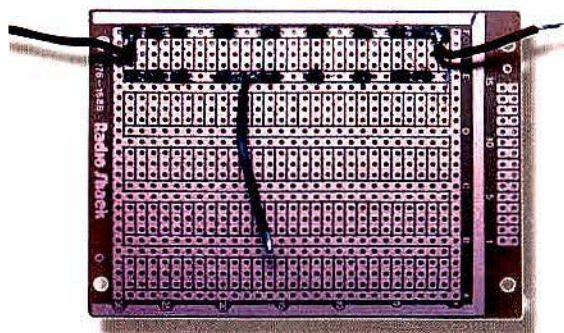


Photo 1. This perforated board is used to describe how to locate a short circuit on a circuit board using a digital voltmeter, a 1.5V cell and a current-limiting resistor. The circuit trace between the black wire and the red wire will serve as the A+ rail. The lower trace, to which a green wire is attached, will serve as the ground rail.

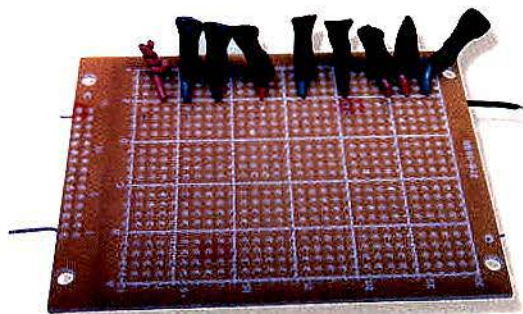


Photo 2. Several twisted wire pairs are connected between the A+ rail and ground to simulate components. Only one of the twisted pair is shorted. The object is to locate the shorted component on the board.

Contributing editor Kinley, MRT's technical consultant and a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is the author of *Standard Radio Communications Manual, with Instrumentation and Testing Techniques*, which is available for direct purchase. Write to 204 Tanglewyde Drive, Spartanburg, SC 29301. His email address is hkinley@home.com.

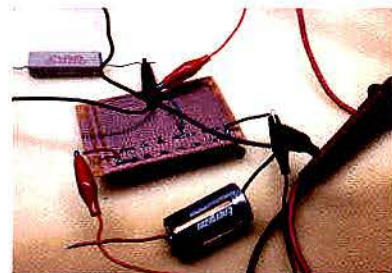


Photo 3. Some of the components used in this procedure are shown here. The digital voltmeter is out of the picture. Shown are the 1.5V C cell, the 2.2W resistor, the circuit board and interconnecting jumper leads.

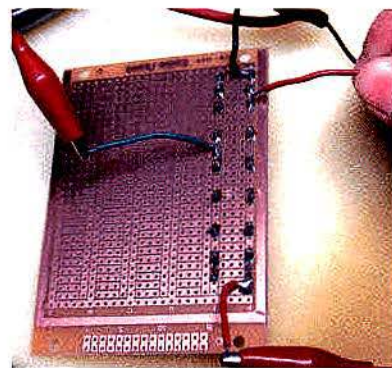


Photo 4a. Here, the positive side of the C cell is connected to the A+ rail. The voltmeter reading is shown in Photo 4b.



Photo 4b. With the voltage probe of the C cell connected as shown in Photo 4a the voltmeter indicates -4.3mV. The negative sign indicates that the short lies in the direction of the positive side of the voltmeter connection.

voltage indication on the digital voltmeter. The digital voltmeter is set to read dc voltage on the 200mV scale. Any printed circuit has a finite amount of resistance, and a current flow through this



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SS-18	15	18	1 1/2 x 6 x 9	3.6
SS-25	20	25	2 1/4 x 7 x 9 1/2	4.2
SS-30	25	30	3 1/4 x 7 x 9 1/2	5.0

DESKTOP SWITCHING POWER SUPPLIES WITH VOLT AND AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SS-25M*	20	25	2 1/4 x 7 x 9 1/2	4.2
SS-30M*	25	30	3 1/4 x 7 x 9 1/2	5.0

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SRM-12	10	12	3 1/2 x 19 x 9 1/2	4.7
SRM-18	15	18	3 1/2 x 19 x 9 1/2	5.0
SRM-25	20	25	3 1/2 x 19 x 9 1/2	6.5
SRM-30	25	30	3 1/2 x 19 x 9 1/2	7.0

WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25M	20	25	3 1/2 x 19 x 9 1/2	6.5
SRM-30M	25	30	3 1/2 x 19 x 9 1/2	7.0

2 ea SWITCHING POWER SUPPLIES ON ONE RACK PANEL

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25-2	20	25	3 1/2 x 19 x 9 1/2	10.5
SRM-30-2	25	30	3 1/2 x 19 x 9 1/2	11.0

WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25M-2	20	25	3 1/2 x 19 x 9 1/2	10.5
SRM-30M-2	25	30	3 1/2 x 19 x 9 1/2	11.0

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SS-101F, SS-121F
SS-10TK
SS-12TK OR SS-18TK
SS-10SM/GTX
SS-10SM/GTX, SS-12SM/GTX, SS-18SM/GTX
SS-10RA
SS-12RA
SS-18RA
SS-10SMU, SS-12SMU, SS-18SMU
SS-10V, SS-12V, SS-18V

CIRCLE (18) ON FAST FACT CARD

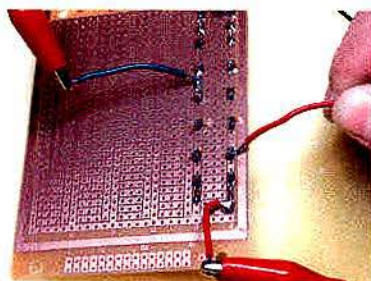


Photo 5a. The voltage probe of the C cell is moved down the A+ rail toward the positive side of the voltmeter. The voltmeter reading is shown in Photo 5b.



Photo 5b. With the voltage probe of the C cell connected as shown in Photo 5a the voltmeter indicates +4.4mV. (The plus sign is understood.) This indicates that the short circuit lies in the direction of the negative side of the voltmeter connection.

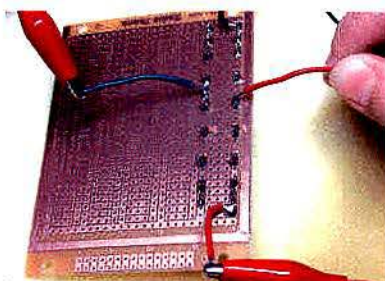


Photo 6a. Because the two connections so far have been on either side of the shorted component, this connection splits the difference to home in on the short circuit. The voltmeter indication is shown in Photo 6b.



Photo 6b. With the voltage probe of the C cell connected as shown in Photo 6a the voltmeter indicates 0.00. This is the location of the short circuit.

resistance will produce a voltage drop. This voltage drop will lead directly to the exact point of the short circuit between the A+ rail and ground. The 2.2Ω resistor is used to limit the current flow to a safe level to avoid destroying the foil on the circuit board.

In Figure 1a, the negative terminal of the "C" cell is connected to ground through the resistor. The positive side of the "C" cell is temporarily connected to the A+ rail, and the voltmeter reading is observed. If the positive side of the "C" cell is connected between the point of the short circuit and the positive side of the voltmeter, then the voltmeter reading will be positive, as shown in Figure 1a.

If the positive side of the "C" cell is connected to the A+ rail between the point of the short circuit and the negative side of the voltmeter, then the voltmeter reading will be negative, as shown in Figure 1b. The voltmeter polarity indicates

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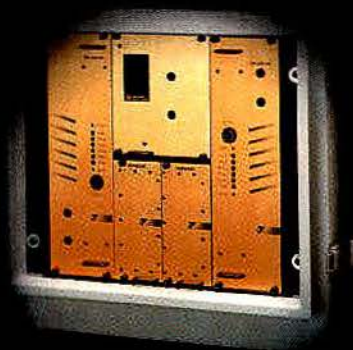
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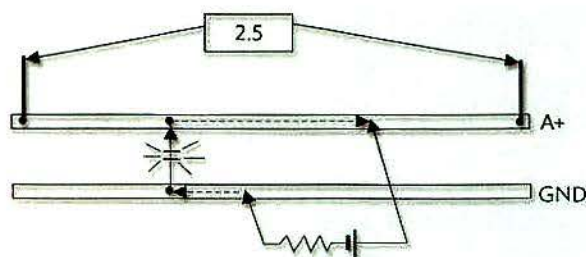
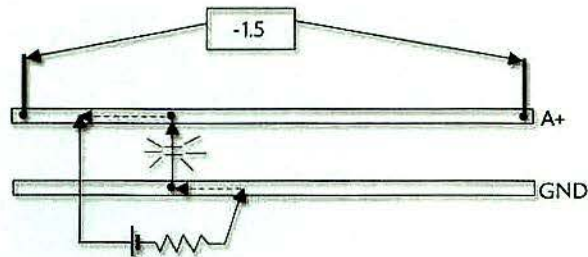


Figure 1. (a) The voltage supply probe is touched to the A+ rail between the short and the positive side of the voltmeter. So, the voltmeter reading is **positive**, and the current level produces a voltage drop of 2.5mV across the A+ rail.

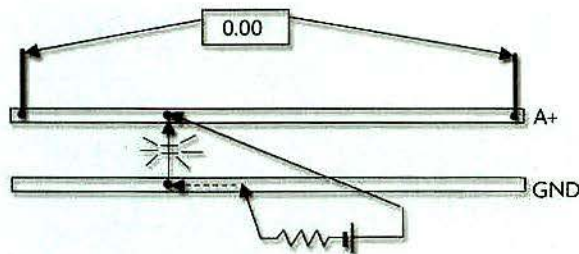


(b) The voltage supply probe is touched to the A+ rail between the short and the negative side of the voltmeter. The voltmeter reading is then **negative**, and the current level produces a voltage drop of 1.5mV across the A+ rail.

the direction where the short circuit lies. The object is to find the point where the voltage reading is **zero**. This is shown in Figure 1c, where you will note that there is no current flowing in the A+ rail; thus, no voltage drop is produced. The current flows only through the ground rail and through the shorted capacitor.

The photos, along with Figure 1, explain how the procedure works. The procedure is certainly worth using if you are stuck on a short-circuit problem, and the equipment required is readily available in any radio shop.

Until next time—*stay tuned!*



(c) The voltmeter supply probe is touched directly to the point of the short circuit. Therefore, no current flows through the A+ rail and the voltmeter reads 0.00. This indicates the location of the short circuit. Bingo!

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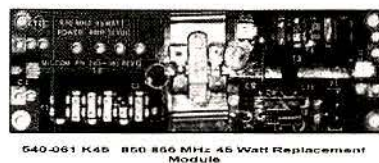
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CIRCLE (24) ON FAST FACT CARD

700MHz

Trick or Treat?

The 700MHz guardband auction lured several masqueraders with outstretched gunnysacks. When the radio industry finally sees some results, will 700MHz be a treat or a trick?

By Kari Taylor

What's been happening with the 700MHz band that's supposed to be turned over to PLMR and CMRS?

The three main uses (public safety, commercial and guardband) are developing at different speeds. Public safety has free spectrum, but there is no type-accepted equipment and most of the urban allotment is still held by incumbents. The auction for the 30MHz-wide commercial segment is still on hold while the FCC tries to get the auction and service rules in place. (The government is anxious because the licenses are expected to net \$25 billion-\$30 billion in revenue.) There is some activity, however, on the 700MHz guardbands.

The guardband auctions concluded in February. *MRT* spoke with Mark Crosby, president of Access Spectrum, Bethesda, MD, (one of the three main winners in the guardband auction), about how it plans to use its 21 Major Economic Area blocks acquired for \$78 million. Because the guardband manager concept is new, Access Spectrum is learning as it goes. The company's strategy was to buy as much unencumbered spectrum as possible and then lease it.

Taylor is associate editor. Her email address is ktaylor@primediabusiness.com.

"We didn't see any merit in bidding above a certain price for cities where the encumbrance issue may not be resolved for five to seven years," Crosby said. About 88% of Access Spectrum's MEAs are not encumbered by the legacy UHF TV stations whose migration is making the band available for wireless.

As a GBM, Access Spectrum intends to lease its procured spectrum, at a flat rate, to private carrier networks such as campuses, utilities, railroads, construction companies and manufacturers. Access Spectrum wants private carriers who lease spectrum from it to know they are going to a safe, secure place that enhances their investment in equipment and in lease fees.

Crosby's analogy is a "gated community" vs. an "RV camp." At an RV camp, anyone can come in and pick a spot anywhere. You don't know if illegal campers are there or if they are using the facilities properly. You don't know your neighbors. The guardbands will be closed regulated—a gated community with neighborhood association rules.

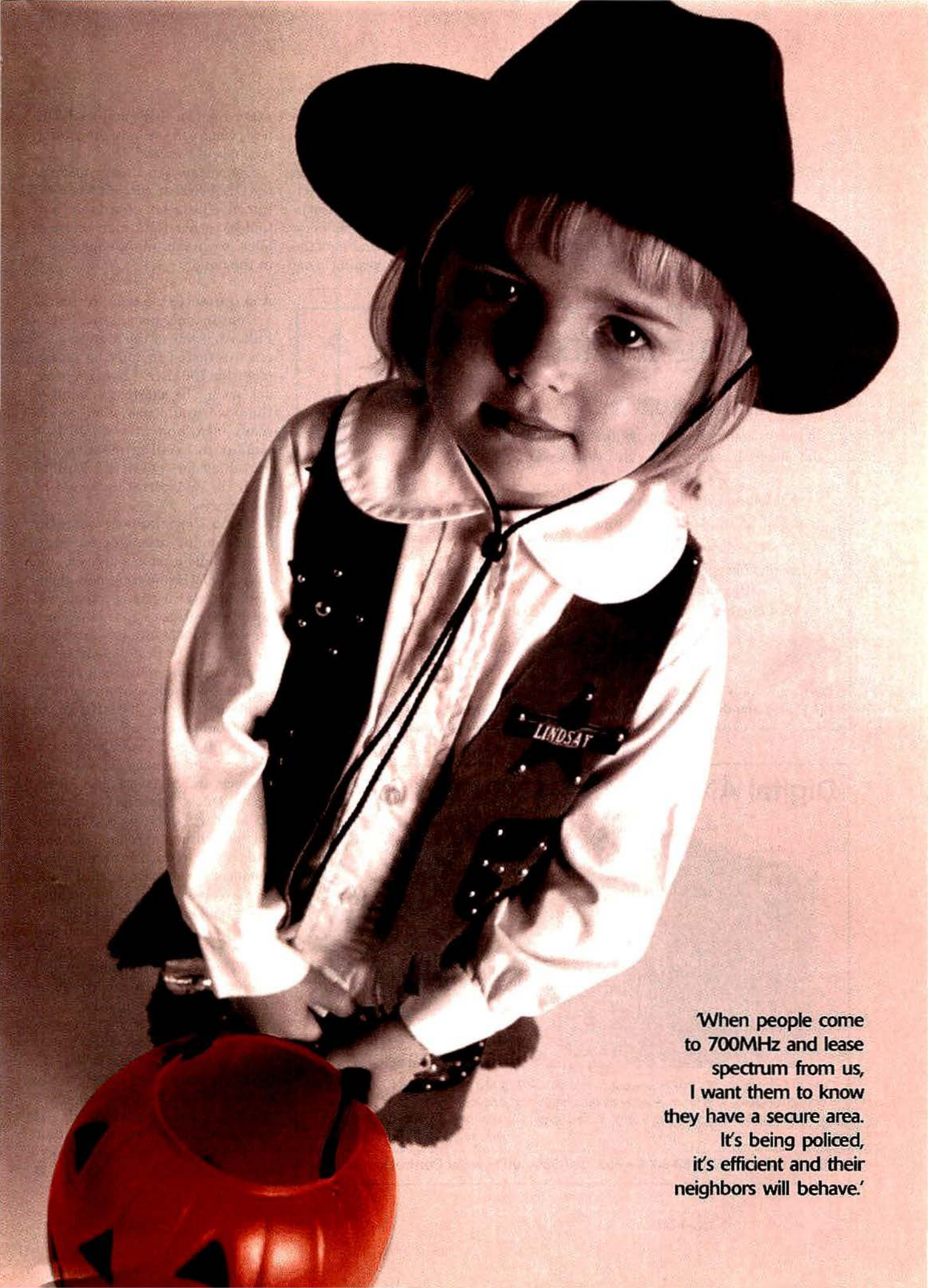
"We're going to let people design their blueprints and then tell us what they want protected," Crosby said. "Before you turn on your system, in accordance with our lease, we're going to do an audit check to make sure that you've designed it

properly. Once the system is on the air, we're going to come back and do annual—maybe *semiannual*—compliance checks for operational characteristics. When people come to 700MHz and use us, and lease spectrum from us, I want them to know they have a secure area. It's being policed, it's efficient and their neighbors will behave."

If there is interference between two GBMs' customers (e.g., an Access Spectrum customer and a Pegasus customer) the GBMs must, by FCC rule, work together to fix the problem. "I think you have to have a relationship among the band managers before you go out there. You need to know what they are doing, and they need to know what we're doing. I'm not concerned because I think we'll have a viable working relationship with the other band managers. It's in both of our interests to work together on this type of thing, and I think that's what the commission wants," Crosby said.

There is buzz that Access Spectrum and Pegasus have been in conversation regarding some form of co-operation or commercial joint venture, but the nature of the negotiations is being kept under wraps.

The biggest hurdle Crosby has had to jump so far is finding manufacturers to produce 700MHz equipment. "You would think that the



'When people come
to 700MHz and lease
spectrum from us,
I want them to know
they have a secure area.
It's being policed,
it's efficient and their
neighbors will behave.'

manufacturers who produce equipment for the private wireless industry would be banging on our door, but that's not the case," said Crosby. "We've spent a lot of time with six to eight manufacturers to induce, to entice, to lobby and to convince them that this is a great place for them to produce equipment."

Creating product isn't instantaneous (it's more like a 9- to 12-month process to do the engineering, marketing and actual manufacturing), so OEMs want to make the right decisions. Crosby said his initial disappointment in readiness has been overcome by an understanding of the timetable. "It was eye-opening to me

when I got in there and said 'OK, boys, when can you have product? ... A couple of *months*?'"

One suggestion Crosby made to the OEMs was to concentrate their initial efforts on affordable portables, rather than high-cost mobiles, to enable rapid deployment in the band.

A manufacturing treat or trick?

ComSpace's president, Steve Fulford, is one of the manufacturers interested in making equipment for 700MHz. "To get a product out in the shortest amount of time, we would use what we already own, and they would look similar to existing mobiles and portables for 800MHz," Fulford said. He said portables would be the priority.

David Confalonieri, business development manager for Motorola's radio products division, believes 700MHz offers great opportunities, and the new spectrum will be able to release some of the pent-up demand. "Motorola's intention is to release the Professional series of products, as well as supporting trunked and conventional infrastructure, in the 700MHz guard band, commencing around the second half of 2002," Confalonieri said.

Lou Orsini, manager of wideband products and engineering for Microwave Data Systems, believes 700MHz will offer his customers a way to continue to roll out services without the risk of using license-free products for mission-critical data. "We are researching the changes that would be required to bring our point-to-multipoint radios down into this frequency band. Prototypes of this product line should be running at the end of the fourth quarter of this year," Orsini said.

Even though the 700MHz commercial auction has stalled, and public safety's allocation of 24MHz isn't becoming useable as quickly as most would like, at least there is activity on the guardbands. At this point, it appears that rather than being half-empty, the gunny-sacks are half-full. ■

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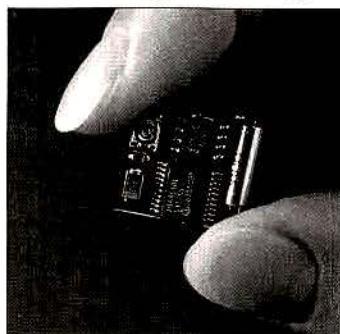
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Multiple choices for critical communications

When facing the design of a private wireless network, many public agencies and private companies encounter a "one technology fits all" approach by vendors.

By Ron Bender and Jay Herther

As the expression goes, "When all you have is a hammer, every problem can look like a nail." One technology does *not* optimally fit all applications. There are several new

points of coverage can drive up the cost of a system exponentially unless there is a cost-effective alternative to traditional tower sites. Furthermore, as the public, local governments and environmental

low-power base station (a single channel with two to four talk paths) is required to provide spot or fill-in coverage. The cell site uses a leased telephone line, a microwave link or a spread-spectrum radio connection for network access. The cell site is self-contained, meaning the unit is self-cooled and no separate HVAC is required. The unit is contained in a weatherproof enclosure and equipped with a battery backup.

The cell site can also be used for selective in-building coverage. The primary benefit is that it is easy to deploy—on a telephone pole, a building or an existing tower—lowering the installed cost of coverage as compared to a traditional tower site.

A complete, high-powered, high-profile tower site can cost more than \$500,000. This includes site access, power, microwave connectivity, the equipment shelter, the antenna system(s), the tower and lighting, plus the base-station RF equipment. A cell site, however, can be constructed for less than \$50,000, making it possible to deploy 10 sites for the cost of one traditional tower site.

Vehicle tactical network (V-TAC)

Cellphone users know it is difficult to achieve ubiquitous, in-



Figure 1. A seven-site simulcast system uses the same frequency at all sites.

technology choices for critical communications, and each addresses the "three Cs" of critical communications: coverage, capacity and cross-agency interoperability.

Coverage

High-powered, high-profile radio sites have historically been the primary infrastructure alternative in land mobile radio. Typically, tower sites provide most of the coverage, but they are not a cost-effective way to reach the dead spots and critical building areas. Most public safety specifications require a 95% level of coverage. The last few percentage

organizations make it more difficult to obtain high-profile tower sites, there is a greater need to use less-obtrusive, low-profile cell sites for local coverage on demand. Let's examine the operations and benefits of low-profile cell sites and mobile repeater stations, alternative technologies that provide complementary coverage to traditional, high-profile infrastructure.

Cell sites

Cell sites (typically pole-mounted base stations, such as M/A-COM's OpenSky system) are best suited for low-density applications where a

Bender is a technology marketing manager and Herther is the director of product integration for the M/A-COM Wireless Systems Business unit. M/A-COM, Inc., a unit of Tyco Electronics, has completed its acquisition of Com-Net Ericsson Critical Radio Systems. This new business is now part of M/A-COM's Wireless Systems organization. For more information: www.macom-wireless.com or www.opensky.com.

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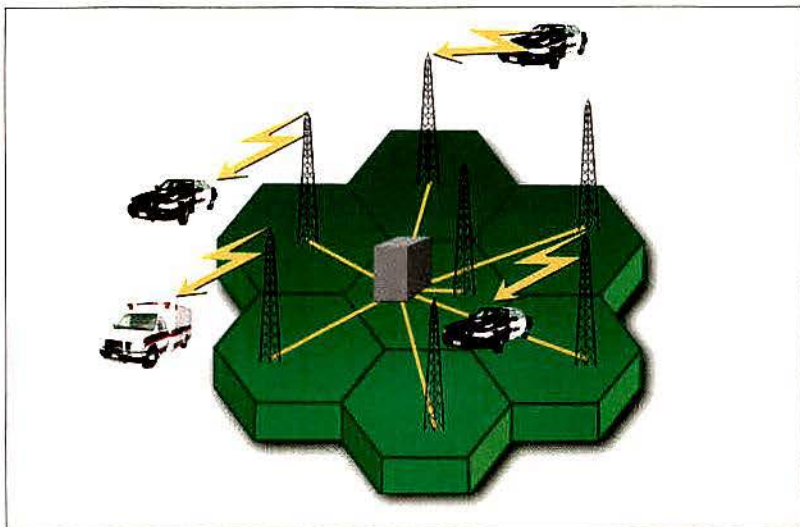


Figure 2. A multisite system repeats the call group only for the required sites.

building coverage. Although the portable radios used in private wireless networks have five times the transmit power of commercial cellphones (3W vs. 0.6W), in high-loss buildings the possibility still exists that communications will be lost at a critical time. The OpenSky V-TAC is a new application of vehicle repeater technology that provides critical in-building communications. This vehicle tactical network is a time-division, multiple-access-based repeater installed in the vehicle. Historically, in-band vehicular repeaters have been difficult to implement because of self-interference and difficulty in coordinating multiple repeaters at the same scene. The tactical network avoids these issues by using frequency agility and the time separation of TDMA to ensure reliable operations without interference.

A vehicle-tactical network is automatically activated by a user's portable device when he is unable to directly access the network. This ensures that a radio user entering a building will not lose network communications. Network services and all system features are maintained when the communications path is rerouted to the V-TAC.

Capacity

Spectrum is scarce and costly. In many existing mobile radio networks, current traffic exceeds the capacity of the network, and suffi-

cient radio spectrum is not available for network expansion. New designs must provide a significant increase in capacity for voice and data applications. The following technologies increase capacity:

- ❑ *Trunking* enables multiple groups to independently access shared radio resources.
- ❑ *Simulcast systems* minimize the spectrum required for high-density applications.
- ❑ *Combining voice and data* into one IP network avoids installing separate infrastructures.
- ❑ *Compression of voice messages* using voice-over-Internet protocol increases network backhaul capacity.
- ❑ *Spectrum efficient TDMA* increases capacity without adding spectrum.
- ❑ *Internet protocol technology* increases channel sharing, reliability and redundancy.

Simulcast vs. multisite

A number of comparisons can be made between simulcast systems and multisite networks, but the primary consideration is *capacity*. Simulcast systems use the same frequencies at all sites in the system. They can be more efficient than multisite networks from a capacity standpoint if a channel at all sites is needed for all group calls. In many cases, however, particular group calls only require a channel at a

Continued on page 34

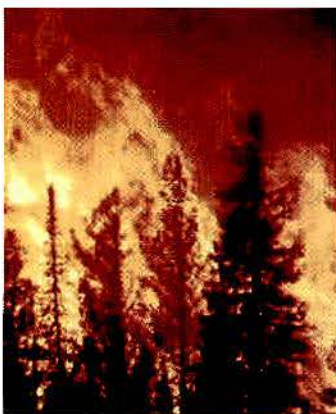
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subset of the sites, such that a multisite network is often a more efficient deployment of scarce spectrum resources and customer budgets. An example of a seven-site simulcast system is shown in Figure 1 on page 30.

Note that all sites repeat each call on the same RF frequency. If the three patrol cars and the ambulance shown in the figure are selected for the same talk group, then three of the sites will be transmitting even though no units on the talk group are within the coverage area of those sites. If this system were configured for multisite operation instead of simulcast, then only the required sites would repeat the group call, as shown in Figure 2 on page 32.

Where FDMA-simulcast fits

Traditionally, simulcast systems, such as Enhanced Digital Access Communications Systems, have been deployed in many medium-sized or large counties and cities where frequencies were insufficient to construct a multisite network. A typical simulcast system for a large city or county might involve more than five sites and more than 20 channels. When a majority of the talk groups on the system are expected to be dispersed across the entire coverage area, or where frequency constraints exist, simulcast may continue to make sense for these systems.

Where multisite fits

Multisite networks are ideal for covering large areas such as a major utility or a statewide system where ample frequencies are available. They will also cover large areas where available frequencies can be sufficiently reused. For cities and counties, multisite can be the best choice if their talk groups are small or stay in local areas, or if there are ample frequencies—which in the past was the primary issue. The enhanced capacity of TDMA has redefined the standard of what is considered an ample quantity of frequencies for building a multisite network. While simulcast still has its place in the system designer's toolbox, the availability of TDMA

technology will now cause some cities and counties to consider a multisite solution. Also, traditional multisite implementations can now achieve much greater capacity by the use of TDMA.

Spectrum-efficient TDMA

TDMA enables simultaneous calls on each RF channel, without dedicated control channels, offering more than a two-to-one cost-to-benefit ratio for capacity over a traditional trunked system. Compared to a traditional frequency-division, multiple-access radio system that requires three frequencies and three base stations (a control channel and two working channels), a two-slot TDMA system requires only one frequency and one base station to achieve the same call capacity. In this case, the TDMA system has three times the spectral efficiency. In a four-slot TDMA configuration, the spectral efficiency advantage increases to five to one. The resulting benefit is less equipment required and less cost per unit of traffic. Figure 3 on page 35 illustrates the effect of TDMA on capacity. The figure compares four-slot TDMA and two-slot TDMA (with control integrated within the working channel) to FDMA systems (with dedicated control channels). The voice users supported by each system are shown for a sample traffic profile to achieve a 1% busy-hour grade-of-service. Two curves are shown for FDMA systems to account for the reduced system capacity caused by the "hang-time," which is typical for an EDACS system at the end of calls that are made in a message-trunked system.

The data show that to support about 1,000 users, an FDMA system that is not set up for message trunking (no hang time) requires 13 channels (12 working channels and one control channel). A message trunked system requires 16 channels. For the TDMA systems, only six channels and three channels are required for two-slot and four-slot, respectively. The power of TDMA is even more evident when comparing users supported by a fixed number of frequencies. Using the sample

voice traffic profile for a trunked site with five frequencies, an FDMA system using message trunking supports about 116 users, increasing to about 155 users without message trunking. The two-slot TDMA system supports 772 users, and a four-slot TDMA system supports more than 2,000 users.

Cross-agency interoperability

Interoperability is crucial for interagency cooperation in public safety and public service applications. When faced with a serious threat to public safety, multiple public safety agencies are typically required to work across agency and jurisdiction boundaries to achieve a coordinated, integrated incident response. Responding agencies must be able to communicate with other cooperating agencies from within and from outside their normal area of jurisdiction.

Some vendors claim that interoperability can be achieved if everyone buys their technology. However, radios and infrastructure should support a range of interoperable solutions to enable interagency communications for coordinated emergency response. Multimode software-based user radios can communicate using various digital and analog modes. Infrastructure supports network interconnection with other analog and digital radio systems. M/A-COM radio users, for example, can take advantage of the following forms of interoperability:

- ☐ direct mode connections to conventional analog radios.
- ☐ direct mode connections to digital radios using a P25 common air interface as an interoperability standard.
- ☐ radio access to conventional mutual aid channels (NPSAC).
- ☐ networked interoperability with users of analog conventional systems.
- ☐ networked interoperability with users on other analog and digital trunked systems.

Building a network

Customizing a design based on technology building blocks is the

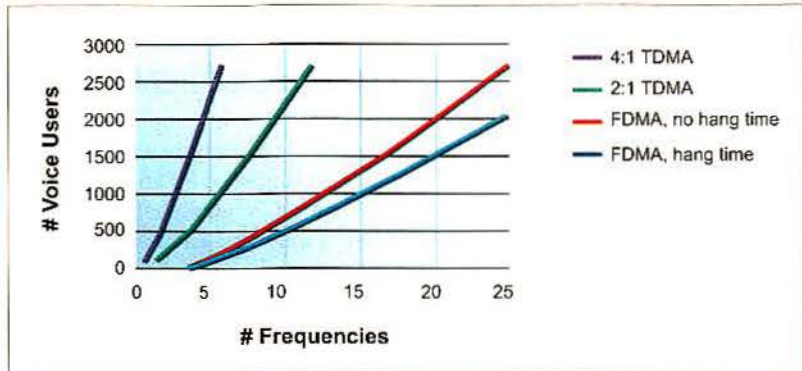


Figure 3. Comparison of capacity between TDMA and FDMA.

key to successful mission-critical communications systems. The best approach to meeting these communications needs is to first understand the available technologies and the associated performance and cost trade-offs, and then to select the optimum combination of technologies for a specific application. There

are many technology choices in critical communications, so use a vendor that can act as an open "technology broker" in making sure that the right technology is applied to a customer's requirement. With multiple tools in the toolbox, every problem does not have to look like a nail. ■

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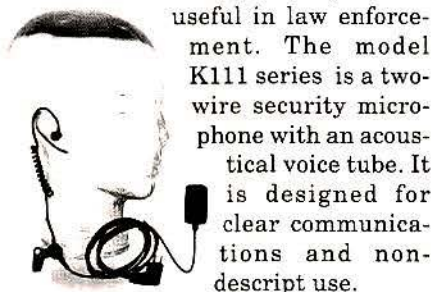
Microphones meet military specifications

The KMC-25 microphone from **Kenwood** is compatible with the two higher-tier Kenwood 80 and 90 series portables built for public safety/service and heavy industry. The KMC-26 public safety speaker microphone is designed exclusively for the 90 series VHF highband and UHF radios. Both microphones meet military specifications 810 C, D and E in 11 categories, such as driven rain, cold, heat, dust, salt, vibration and fog.

WWW.KENWOOD.COM

Mics suit safety apps

The K85 series is a public safety two-wire surveillance microphone from **Klein Electronics** with a front facing, dual-button PTT switch and black or clear acoustical audio tube. This microphone is



useful in law enforcement. The model K111 series is a two-wire security microphone with an acoustical voice tube. It is designed for clear communications and non-descript use.

WWW.HEADSETUSA.COM

Mic fits inside ear

The bone microphone tactical headset from **Television Equipment Associates** fits inside the ear and has mic intelligibility comparable to boom mics. The headset and receiver are incorporated into a tiny generic earmold that does not substantially obstruct peripheral hearing and will not interfere with SCBA breathers—important features for SWAT, fire entry or HAZMAT applications.

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Mic offers rotating clothing clip

The **ParMarLow** SM-1100 speaker microphones are weatherproof units with audio earphone plugs. The microphone comes standard with a rotating clothing clip and a coil-cord wired to the specific mating connector for your radio. The tactile-feel, thumb-sized PTT switch is fully enclosed in a rubber boot.

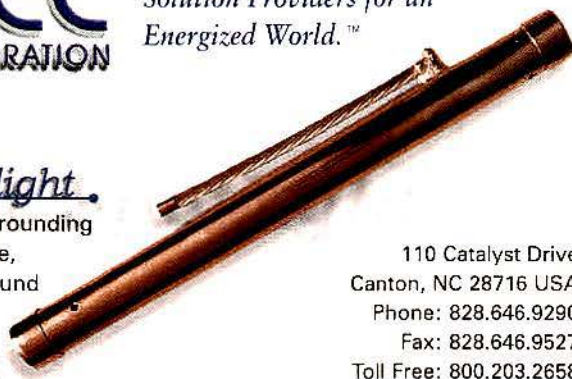


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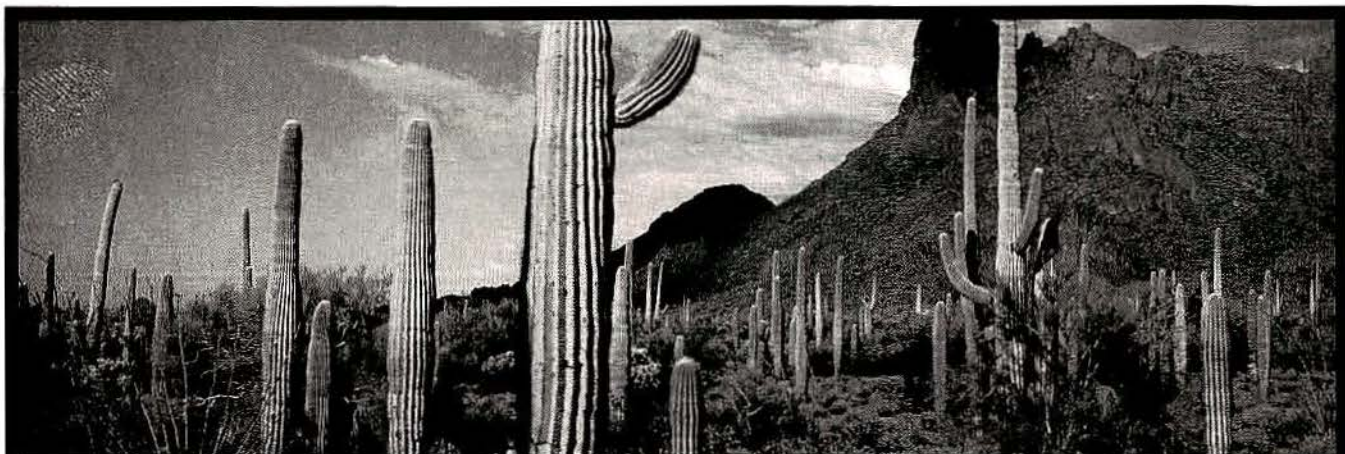
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Protectors feature low PIM values



Huber + Suhner's 3409 series lightning protectors offer a low PIM value of -150dBc , which provides protection for mobile communications transceivers with dc-powered outdoor equipment. These high-power gas capsule

protectors have a frequency range of 800MHz to 18GHz (N-interface), providing coverage for current and future frameworks of cellular, PCS and UMTS applications. These units have a minimum IP65 rating and are available in a variety of connector types, mounting styles and frequency ranges.

WWW.HUBERSUHNERINC.COM

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1	HT50 and the Radius P100 Models	\$59. ⁹⁵
2	HT600, MT800, MT1000, P200, P500, MTX800, MTX810, MTX820, MTX900. (connection on top of radio)	\$85. ⁹⁵
3	MARATAC (MAXTRAC - 50, 100, 300, 820, 840, M860). (RADIUS - M100, M206, M208, M214, M216, M400, GM300), SM10, SM50.	\$59. ⁹⁵
3B	MCS-2000	\$59. ⁹⁵
4	STX, STX Gemini, STX 821 trunked portables.	\$79. ⁹⁵
5	SABER and System SABER.	\$99. ⁹⁵
6A	SPECTRA Low and Medium Power Units.	\$79. ⁹⁵
6B	SPECTRA 100 Watt and High Power Units.	\$79. ⁹⁵
7	SYNTRON 9000 and 9000E Radio Line.	\$149. ⁹⁵
9	R100 Repeater.	\$49. ⁹⁵
10	MCX1000.	\$65. ⁹⁵
11	Cloning Cable for the Motorola® HT600 / MT1000.	\$79. ⁹⁵
12A	GP300, GP350, and P110 Models.	\$149. ⁹⁵
13	MSF5000 Digital Unit with 3 Digit Display in Controller Tray.	\$75. ⁹⁵
14	HT1000, MT2000, MTX 838, MTX 8000, MTX 9000 (connection on side of radio) and JEDI Series.	\$135. ⁹⁵
15	Visar Unit.	\$119. ⁹⁵
16	Cloning Cable for the Motorola® JEDI Series.	\$129. ⁹⁵
17	ASTRO SABER and SABER SI.	\$99. ⁹⁵
18	SP50.	\$99. ⁹⁵
19	M1225.	\$59. ⁹⁵
20	P1225.	\$119. ⁹⁵
21	HT750, HT1250.	\$79. ⁹⁵



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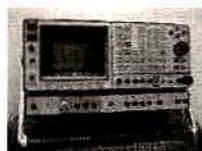
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Communications Specialists manufactures tone-signaling equipment including CTCSS, DCS, DTMF, two-tone sequential, ANI, voice encryption, paging encoders, repeater tone panels, Morse station ID and Part 90 narrowband kits.

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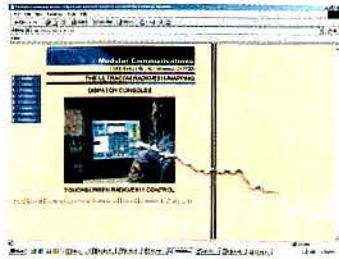
David Clark



David Clark manufactures noise-attenuating headsets and radio adapters for use with more than 350 mobile and portable radios and personal communications devices.

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Modular Communications



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WWW.MODUCOM.COM

Telex Communications



Telex (including VEGA and the Land Mobile Products group) manufactures communications control consoles (from a single line up to 24-line), radio termination adapter panels, amplifiers, line bridging modules along with radio headsets and ear microphones designed for use with most portable radios.

WWW.TELEX.COM

Thales Communications



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WWW.THALESCOMMINC.COM

TX RX Systems



TX RX Systems is a division of the Bird Technologies Group. Visit the Web site for information on multicoupler systems, signal boosters, antennas, duplexers, cavity filters and RF components.

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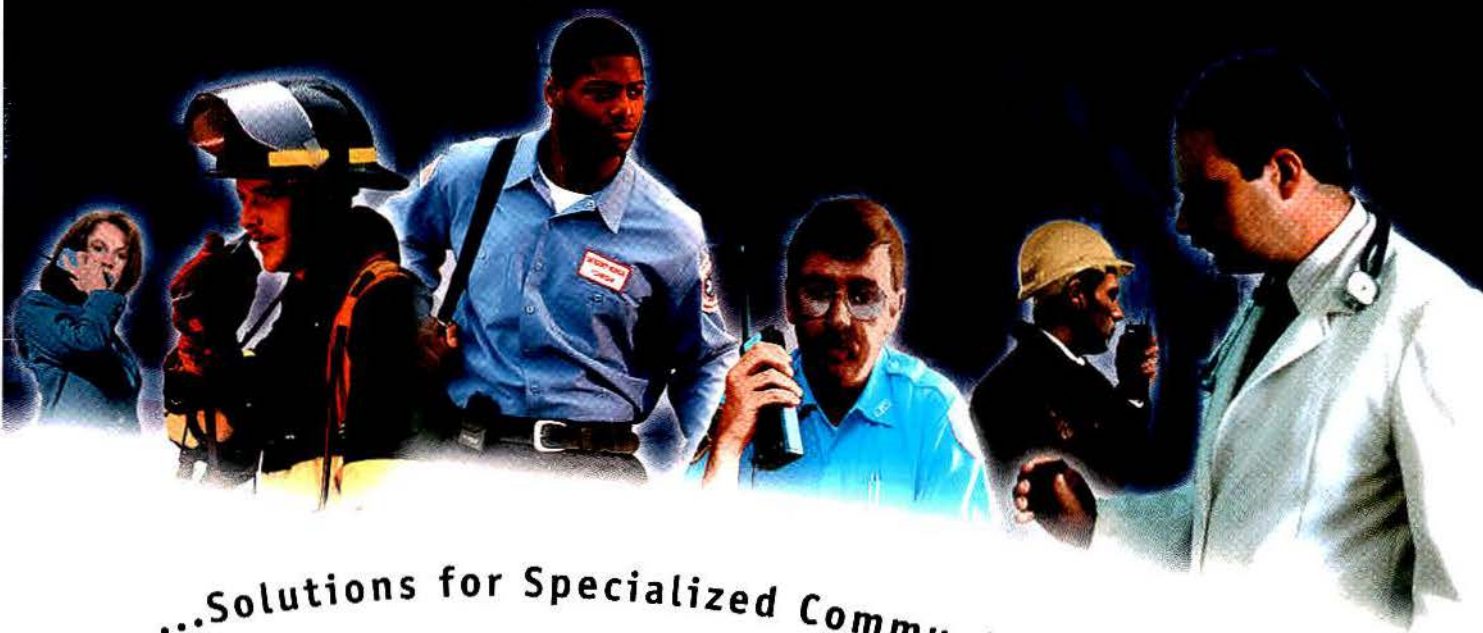
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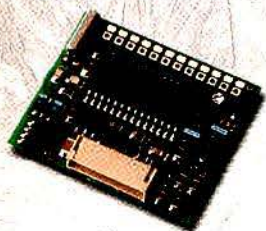
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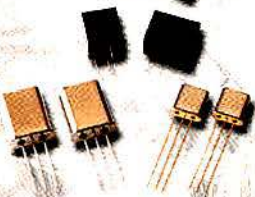
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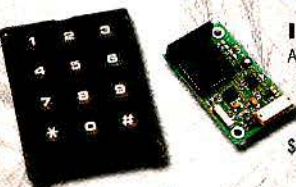
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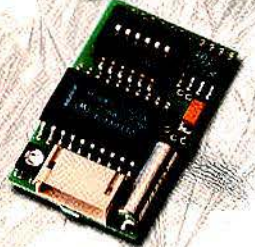
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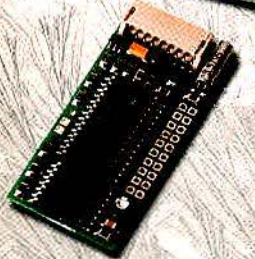
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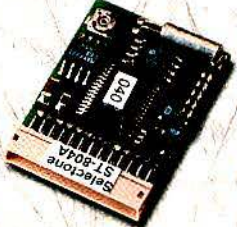
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